

## Effects of chemically induced cationic disturbance on Mn<sup>4+</sup> luminescence in double perovskites - temperature and pressure experimental and computational studies

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### Rok wydania

2023

### Czasopismo

Journal of Alloys and  
Compounds

### Numer woluminu

930

### Strony

167435/1-167435/12

### DOI

10.1016/j.jallcom.2022.167435

### Kolekcja

Naukowa

### Język

Angielski

### Streszczenie

We show the opportunity for tuning of the spectral position of the Mn<sup>4+</sup> red emission in the series of double perovskites, Ba<sub>2</sub>LaNbO<sub>6</sub>:Mn<sup>4+</sup>, Ba<sub>2</sub>La(Nb<sub>0.8</sub>Zr<sub>0.1</sub>W<sub>0.1</sub>)O<sub>6</sub>:Mn<sup>4+</sup>, and Ba<sub>2</sub>La(Zr<sub>0.5</sub>W<sub>0.5</sub>)O<sub>6</sub>:Mn<sup>4+</sup> with increasing chemically induced symmetry disturbance. Such a disorder appeared attractive to engineering phosphors for pressure sensors or horticultural applications, for instance. The goal of the present research, not yet systematically addressed in the literature, was to unveil the correlation between chemically induced controlled crystal lattice distortion and the luminescence of Mn<sup>4+</sup>. For this purpose, the luminescence of these phosphors was methodically investigated at different pressures and temperatures. A pressure-induced redshift of photoluminescent lines with the rate of  $-4\text{ cm}^{-1}/\text{kbar}$  was found within the 0–230 kbar range, and the emission peak moved from 685 to 740 nm then. Furthermore, the cationic disorder allowed tuning of the Mn<sup>4+</sup> luminescence making it useful for horticultural applications with a better fit between the emission wavelength and the strong chlorophyll absorption in the deep red part of the spectrum. The Mn<sup>4+</sup> energy levels were computationally determined using the exchange charge model of the crystal-field theory which allowed for a deeper understanding of the experimental results. We found a correlation between the introduced disorder of the cationic subsystem and the energy of the Mn<sup>4+</sup> emitting <sup>2</sup>E<sub>g</sub> level (R-line) as well as its intensity. This research brought a deeper understanding of the Mn<sup>4+</sup>-activated phosphors and, in turn, provides tips for a prudent search of materials for advanced practical uses.

### Słowa kluczowe

Optical materials, Order-disorder effects, High-pressure, Luminescence, Oxide materials

Typ publikacji

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Artykuł

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<http://dx.doi.org/10.1016/j.jallcom.2022.167435>

Strona internetowa wydawcy

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Plik został wygenerowany dnia 2026-10-06 14:35:52

Adres w repozytorium <https://old.chem.uni.wroc.pl/pl/repozytorium/HILfrXD>.